

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1 1. (Cancelled)

1 2. (Currently Amended) The method of claim [[1]]11, wherein the computer further
2 includes a CPU, wherein the virtual machine monitor is in control of the CPU prior to the
3 runtime virtualization of the I/O device.

1 3. (Currently Amended) The method of claim [[1]]11, wherein the virtualization is
2 performed transparently to [[the]]an operating system.

1 4. (Currently Amended) The method of claim [[1]]11, wherein the I/O device is
2 compatible with the virtualized I/O device.

1 5. (Cancelled)

1 6. (Currently Amended) The method of claim [[5]]11, further comprising
2 configuring [[the]] hardware to trap I/O accesses, and enabling the virtual machine monitor to
3 emulate the I/O device in response to the ~~trap~~trapped I/O accesses.

1 7. (Original) The method of claim 6, wherein the virtual machine monitor uses
2 memory management to trap the I/O accesses.

1 8. (Currently Amended) The method of claim [[5]]15, wherein the virtual machine
2 monitor ~~can commence~~commences the ~~emulation~~virtualization between I/O sequences.

9. (Currently Amended) The method of claim 8, wherein the virtual machine monitor commences ~~emulation~~ the virtualization by intercepting I/O accesses; wherein the virtual machine monitor uses the intercepted I/O accesses to update a state machine, whereby the state machine reflects a state of the I/O device; and wherein the virtual machine monitor examines transitions in the state machine to determine whether the I/O device is in the middle of an I/O sequence.

10. (Currently Amended) The method of claim ~~[[5]]15~~, ~~wherein further comprising the virtual machine monitor can commence the emulation in the middle of commencing the virtualization during~~ an I/O sequence.

11. (Currently Amended) ~~The method of claim 5~~ In a computer including an I/O device, a method comprising using a virtual machine monitor to commence virtualization of the I/O device at runtime, wherein runtime is a period of execution in the computer after boot and before shutdown of the computer, wherein the virtual machine monitor uses a state machine to determine ~~determines~~ whether the I/O device is ~~in the middle of performing~~ an I/O sequence, and delays commencing ~~emulation~~ the virtualization until the ~~state machine indicates~~ virtual machine monitor determines that the I/O sequence has completed.

12. (Currently Amended) The method of claim ~~[[1]]11~~, wherein the runtime virtualization includes using the virtual machine monitor to emulate I/O device interrupts.

13. (Currently Amended) The method of claim ~~[[1]]11~~, wherein I/O device interrupts are directed to an operating system prior to the runtime virtualization of the I/O device; and wherein the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device.

14. (Currently Amended) The method of claim ~~[[1]]11~~, wherein the virtual machine monitor temporarily pauses an I/O sequence by emulating the I/O device as being busy.

1 15. (Currently Amended) ~~The method of claim 1~~In a computer including an I/O
2 device, a method comprising:
3 using a virtual machine monitor to commence virtualization of the I/O device at runtime,
4 wherein runtime is a period of execution in the computer after boot and before shutdown of the
5 computer, wherein the I/O device has multiple modes of operations;
6 ~~wherein the virtual machine monitor determines~~determining the mode of the I/O device
7 prior to commencing the virtualization; and
8 ~~wherein the virtual machine monitor restores~~restoring the determined mode of [[the]]
9 operation after the virtualization.

1 16. (Currently Amended) The method of claim [[1]]11, further comprising
2 devirtualizing the I/O device at runtime following the runtime virtualization.

1 17. (Currently Amended) In a computer including hardware, a method comprising:
2 running a virtual machine monitor~~running~~on the hardware[[,]];
3 running an operating system~~running~~on the virtual machine monitor,
4 wherein the hardware~~including~~includes an I/O device, and the I/O device is already
5 virtualized by the virtual machine monitor[[,]]; and
6 ~~a method comprising~~devirtualizing the I/O device at runtime, wherein runtime is a period
7 of execution in the computer after boot and before shutdown of the computer.

1 18. (Original) The method of claim 17, wherein the devirtualization is performed
2 transparently to the operating system.

1 19. (Original) The method of claim 17, wherein the devirtualization includes stopping
2 I/O device emulation at runtime.

1 20. (Original) The method of claim 17, wherein the virtual machine monitor emulates
2 the I/O device prior to devirtualization; and wherein the devirtualization includes allowing the

3 virtual machine monitor to temporarily stop the operating system from commencing a new I/O
4 sequence.

1 21. (Original) The method of claim 20, wherein the virtual machine monitor
2 temporarily stops the operating system by emulating the I/O device as being in a "busy" or
3 "device not ready" state.

1 22. (Original) The method of claim 20, wherein the virtual machine monitor bounds
2 the amount of time the operating system processing is temporarily stopped.

1 23. (Currently Amended) The method of claim 20, further comprising:
2 ~~wherein~~ the virtual machine monitor ~~[[logs]]~~ logging I/O accesses by the operating system
3 to the I/O device during devirtualization, and
4 ~~replays-replaying~~ the log to the I/O device after devirtualization, ~~[[whereby]]~~ wherein the
5 I/O accesses by the operating system are deferred during the devirtualization of the I/O device.

1 24. (Original) The method of claim 17, wherein the virtual machine monitor waits for
2 I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all
3 expected interrupts from the device to arrive, before ceasing device emulation.

1 25. (Currently Amended) The method of claim 17, further comprising re-directing
2 interrupts from interrupt handlers in the virtual machine monitor to interrupt handlers in the
3 operating system after performing the devirtualizing.

1 26. (Currently Amended) The method of claim 17, further comprising, after
2 performing the devirtualizing, configuring the hardware so ~~[[the]]~~ accesses by the operating
3 system to the I/O device no longer trap to the virtual machine monitor.

1 27. (Currently Amended) The method of claim 17, wherein the I/O device has
2 multiple modes of operations[[:]], the method further comprising:
3 ~~wherein~~ the virtual machine monitor ~~determines~~ determining the mode of the I/O device
4 prior to commencing the devirtualization; and
5 ~~wherein~~ the virtual machine monitor ~~restores~~ restoring the determined mode of [[the]]
6 operation after devirtualization.

1 28. (Currently Amended) The method of claim 17, further comprising
2 virtualizing ~~wherein~~ the I/O device ~~is virtualized~~ at runtime again after [[having]] performing the
3 devirtualizing ~~been devirtualized~~ at runtime.

1 29. (Cancelled)

1 30. (Currently Amended) The computer of claim [[29]]35, wherein the I/O device is
2 compatible with the virtualized I/O device.

1 31. (Cancelled)

1 32. (Currently Amended) The computer of claim [[31]]35, ~~further comprising~~
2 ~~configuring~~ ~~wherein~~ the hardware is configured to trap I/O accesses, and enabling the virtual
3 machine monitor is enabled to emulate the I/O device in response to the trapped I/O
4 accesses ~~traps~~.

1 33. (Currently Amended) The computer of claim 32, wherein the virtual machine
2 monitor [[uses]] is configured to use memory management to trap the I/O accesses.

1 34. (Cancelled)

1 35. (Currently Amended) ~~The computer of claim 34~~ A computer comprising:
2 hardware including an I/O device; and
3 computer memory encoded with a virtual machine monitor for running on the hardware
4 and commencing virtualization of the I/O device at runtime, wherein runtime is a period of
5 execution in the computer after boot and before shutdown of the computer,
6 wherein the virtual machine monitor ~~[[uses]]~~ is configured a state machine to determine
7 whether the I/O device is ~~in the middle of performing an I/O sequence, and delays to delay~~
8 commencing ~~emulation the virtualization until the state machine indicates virtual machine~~
9 monitor determines that the I/O sequence has completed.

1 36. (Currently Amended) The computer of claim ~~[[31]]~~ 35, wherein the virtual
2 machine monitor is configured to temporarily pauses-pause the I/O sequence by emulating the
3 I/O device as being busy.

1 37. (Currently Amended) The computer of claim ~~[[29]]~~ 35, wherein the runtime
2 virtualization includes using the virtual machine monitor to emulate I/O device interrupts.

1 38. (Currently Amended) A computer comprising:
2 hardware including an I/O device; and
3 computer memory encoded with a virtual machine monitor for devirtualizing the I/O
4 device at runtime, wherein runtime is a period of execution in the computer after boot and before
5 shutdown of the computer.

1 39. (Currently Amended) The computer of claim 38, wherein the virtual machine
2 monitor is configured to emulate ~~emulates~~ the I/O device prior to commencing the
3 devirtualization; and wherein the virtual machine is configured to commence ~~commences~~ the
4 devirtualization by temporarily stopping an operating system running on the virtual machine
5 monitor from commencing a new I/O sequence.

1 40. (Currently Amended) The computer of claim 39, wherein the virtual machine
2 monitor is configured to temporarily ~~stops~~ stop the operating system by emulating the I/O device
3 as being in a "busy" or "device not ready" state.

1 41. (Currently Amended) The computer of claim 39, wherein the virtual machine
2 monitor is configured to bound ~~bounds~~ the amount of time the operating system processing is
3 temporarily stopped.

1 42. (Currently Amended) The computer of claim ~~[[39]]~~38, wherein the virtual
2 machine monitor ~~[[logs]]~~ is configured to log I/O accesses by an operating system to the I/O
3 device during devirtualization, and to replay ~~replays~~ the log to the I/O device after
4 devirtualization.

1 43. (Currently Amended) The computer of claim 39, wherein the virtual machine
2 monitor is configured to wait ~~waits~~ for I/Os initiated by a virtual machine monitor driver for the
3 I/O device to complete, and for all expected interrupts from the I/O device to arrive, before
4 ceasing device emulation.

1 44. (Currently Amended) The computer of claim 38, ~~further comprising configuring~~
2 wherein the hardware is configured so operating system accesses to the I/O device no longer trap
3 to the virtual machine monitor after the devirtualization.

1 45. (Currently Amended) The computer of claim 38, wherein the I/O device has
2 multiple modes of operations; wherein the virtual machine monitor is configured to determine
3 ~~determines~~ the mode of the I/O device prior to commencing the devirtualization; and wherein the
4 virtual machine monitor is configured to restore ~~restores~~ the determined mode of [[the]]
5 operation after the I/O device has been devirtualized.

1 46. (Currently Amended) The computer of claim 38, wherein the virtual machine
2 monitor [[can]] is configured to further virtualize the I/O device after having devirtualized the I/O
3 device at runtime.

1 47. (Cancelled)

1 48. (Currently Amended) The article of claim [[47]]52, wherein the virtualization
2 includes commencing I/O device emulation at runtime.

1 49. (Currently Amended) The article of claim 48, wherein the ~~software includes a~~
2 virtual machine monitor; ~~and wherein the software~~ configures the hardware to trap I/O accesses,
3 and enables the virtual machine monitor to emulate the I/O device in response to the trapped I/O
4 devices~~traps~~.

1 50. (Previously Presented) The article of claim 49, wherein the virtual machine
2 monitor uses memory management to trap the I/O accesses.

1 51. (Cancelled)

1 52. (Currently Amended) ~~The article of claim 51~~ An article for a computer including
2 an I/O device, the article comprising computer-readable memory encoded with a virtual machine
3 monitor for causing the computer to commence virtualization of the I/O device at runtime,
4 wherein runtime is a period of execution in the computer after boot and before shutdown of the
5 computer, wherein the virtual machine monitor includes a state machine for determining
6 determines whether the I/O device is in the middle of performing an I/O sequence, the virtual
7 machine monitor delaying the commencement of the emulation-virtualization until the state
8 ~~machine indicates~~ virtual machine monitor determines that the I/O sequence has completed.

1 53. (Original) The article of claim 52, wherein the virtual machine monitor
2 temporarily pauses the I/O sequence by emulating the I/O device as being busy.

1 54. (Currently Amended) The article of claim [[47]]52, wherein the ~~software includes~~
2 ~~a virtual machine monitor for emulating~~ emulates I/O device interrupts during the runtime
3 virtualization.

1 55. (Cancelled)

1 56. (Currently Amended) An article for a computer including an I/O device, the
2 article comprising computer-readable memory encoded with ~~software~~ a virtual machine monitor
3 for causing the computer to devirtualize the I/O device at runtime, wherein runtime is a period of
4 execution in the computer after boot and before shutdown of the computer.

1 57. (Original) The article of claim 56, wherein the devirtualization includes ceasing
2 emulation of the I/O device at runtime.

1 58. (Currently Amended) The article of claim 57, ~~wherein the software includes a~~
2 ~~virtual machine monitor; and~~ wherein the devirtualization includes temporarily stopping an
3 operating system running on the virtual machine monitor from commencing a new I/O sequence.

59. (Original) The article of claim 58, wherein the virtual machine monitor temporarily stops the operating system by emulating the I/O device as being in a "busy" or "device not ready" state.

60. (Original) The article of claim 58, wherein the virtual machine monitor bounds the amount of time the operating system processing is temporarily stopped.

61. (Currently Amended) The article of claim 57, wherein ~~the software includes a virtual machine monitor for ceasing the emulation;~~ the virtual machine monitor waiting-waits for I/Os initiated by a virtual machine monitor driver for the I/O device to complete, and for all expected interrupts from the I/O device to arrive, before ceasing device emulation.

62. (Currently Amended) The article of claim 56, wherein the ~~software includes a~~ virtual machine monitor logs for logging I/O accesses by an operating system to the I/O device during devirtualization, and replaying-replays the log to the I/O device after devirtualization.

63. (Currently Amended) The article of claim 56, wherein the ~~software includes a~~ virtual machine monitor, the software configuring configures the hardware so operating system accesses to the I/O device do not trap to the virtual machine monitor.

64. (Currently Amended) The article of claim 56, wherein the I/O device has multiple modes of operations; and wherein the ~~software includes a~~ virtual machine monitor for determining-determines the mode of the I/O device prior to commencing devirtualization; and restoring-restore the determined mode of [[the]] operation after the I/O device has been devirtualized.

65. (Cancelled)

- 1 66. (Currently Amended) The article of claim ~~[[65]]56~~, wherein the virtual machine
2 monitor ~~[[can]]causes the computer to further~~ virtualize the I/O device after having devirtualized
3 the I/O device at runtime.